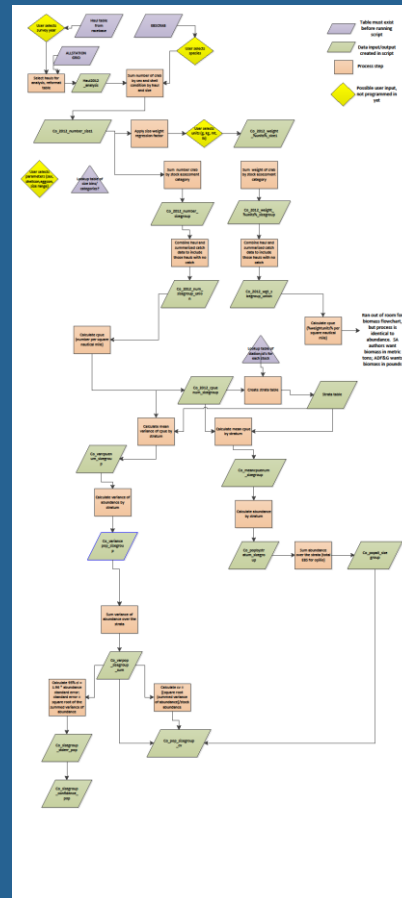




Crab Model Workshop

January 2014



Organization

- Time series: history of changes
 - Unmeasured crab and maturity
- Chionoecetes bairdi time series
 - Strata and stations used
- Future time series
 - No corner stations
 - Only standard tows
 - No hot-spot tows

Time series: history of changes

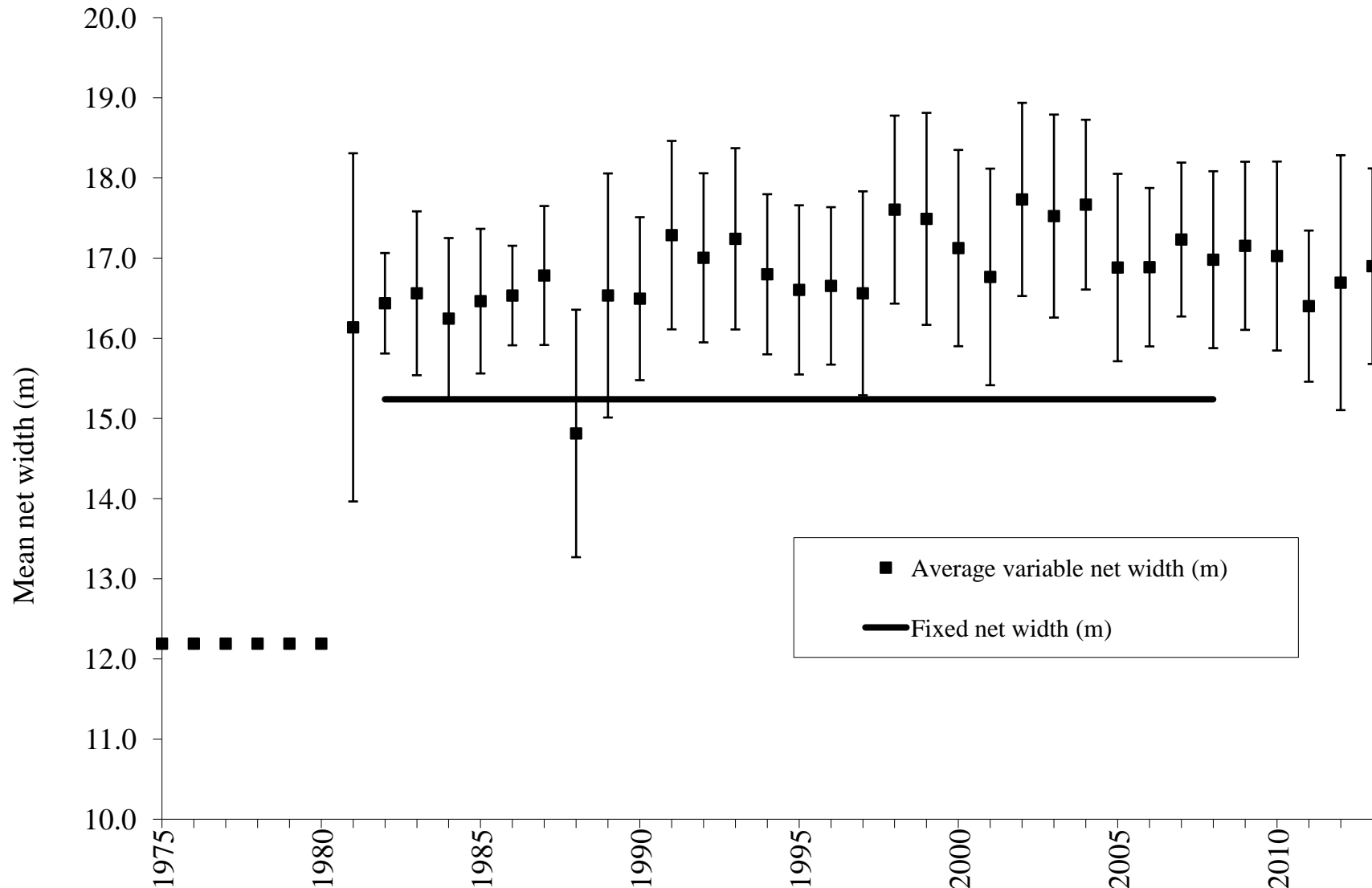
Time series revisions 2008-?

- 2008: Reproduce abundance estimate calculations for entire time series.
 - Early time series data to estimate abundance only available on paper.
- 2009: New time series with error fixes ($<1\%$ Δ)
- 2009: New time series with unmeasured crab (1-25% Δ)
- 2010: New time series with appropriate net width ($<10\%$ Δ)
- 2010: Recalculate time series with NEW length-wt regressions.
- 2013: Mature biomass definition
- Current: Reconsider different time series.

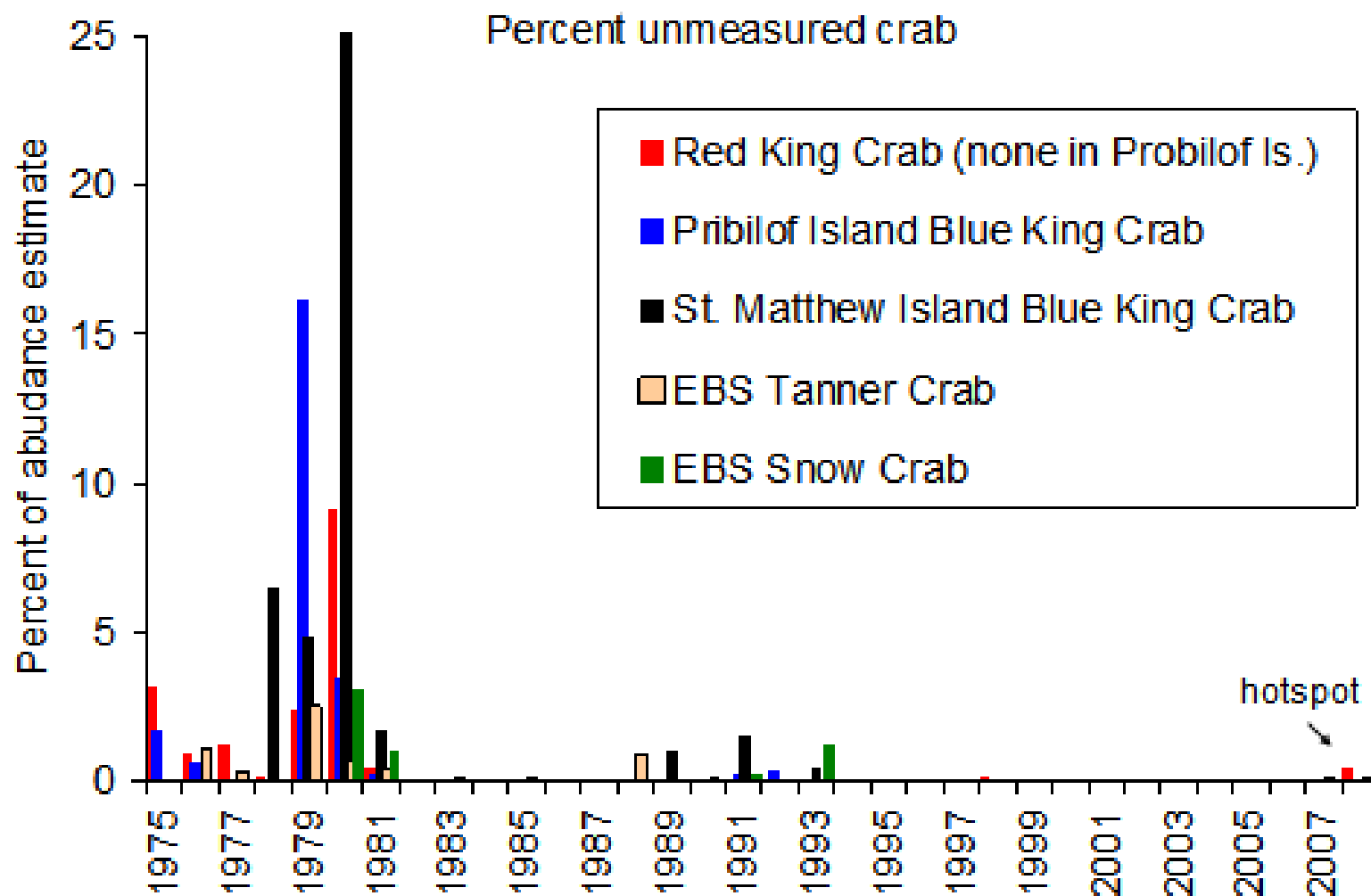
Nets and Net Width

- 1975 – 1980 majority of hauls made using the 400-mesh eastern trawl, which was determined to have a mean path width of 12.19 m.
- 1976 30 tows from 2 vessels towing an 83-112 trawl were used for data analysis; this net was determined to have a mean path width of 17 m.
- 1981 both 400-eastern (2 nets: 13.4 m and 14.3 m) and 83-112 trawls (18 m) used.
- 1981 Net mensuration for first time!
- 1982 - 2013 83-112 trawl used by all vessels.
- 1982 – 1986 net widths estimated with rudimentary equipment and were usually made once per season.
- 1987 Better net mensuration equipment used (SCANMAR, NETMIND). 1982-1987 surveys net width re-estimated using new relationship to replace fixed width.
- 1996 A bottom contact sensor used.
- 2009 Measured net width data used in crab abundance estimates.

Net Width



Unmeasured crab (999s)

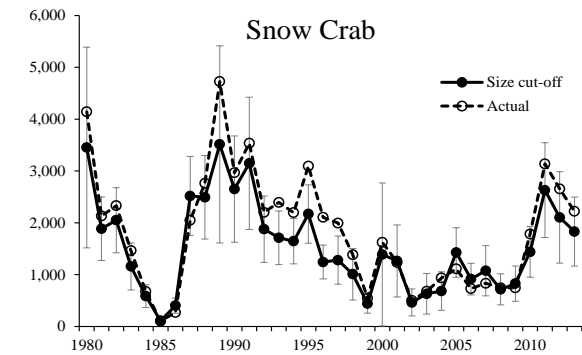
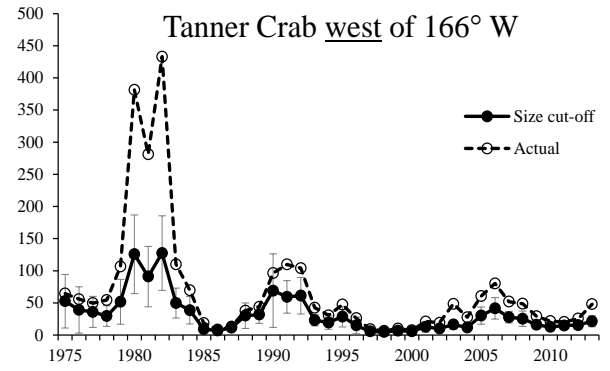
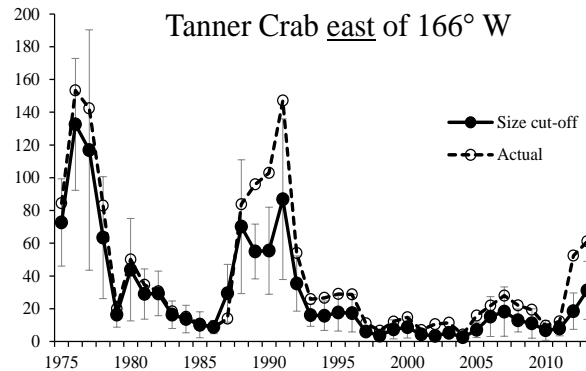
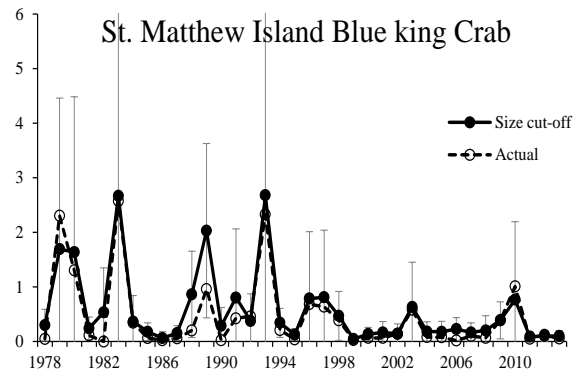
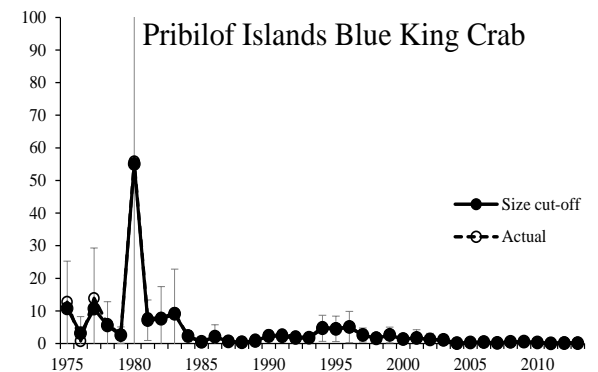
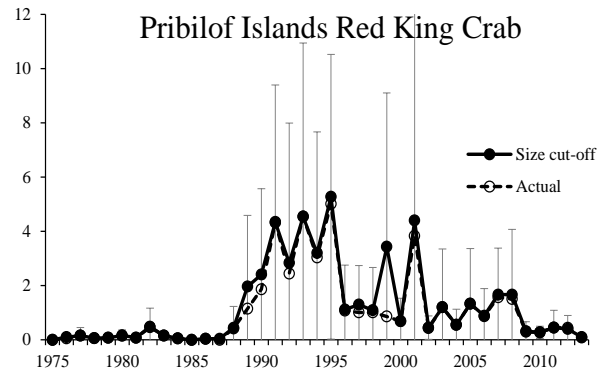
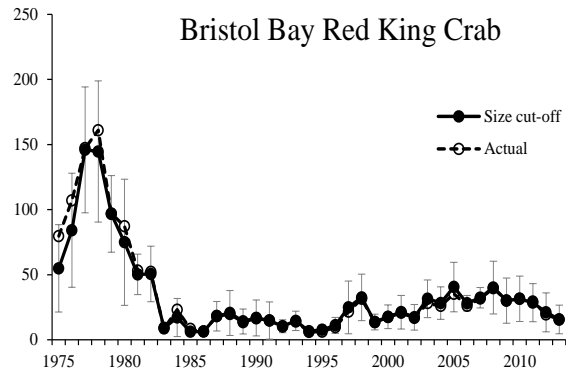


Mature biomass definition

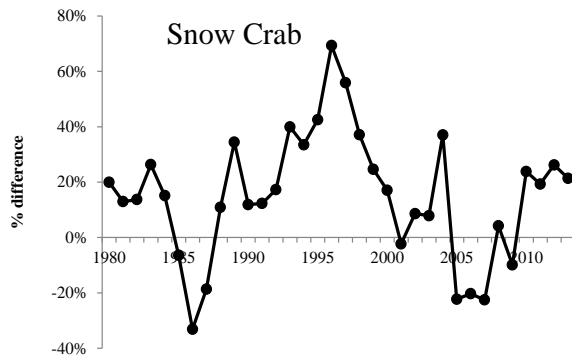
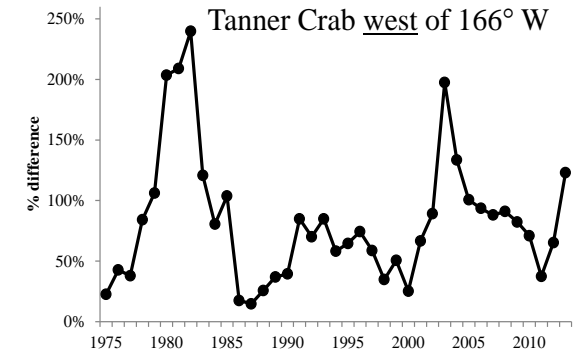
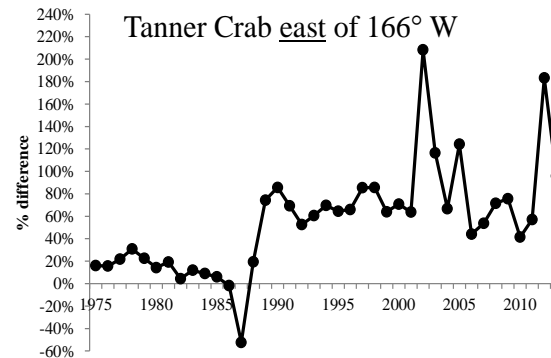
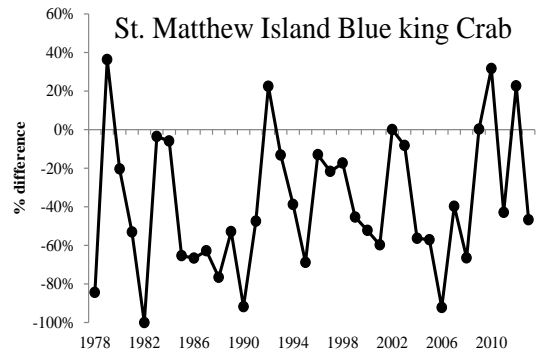
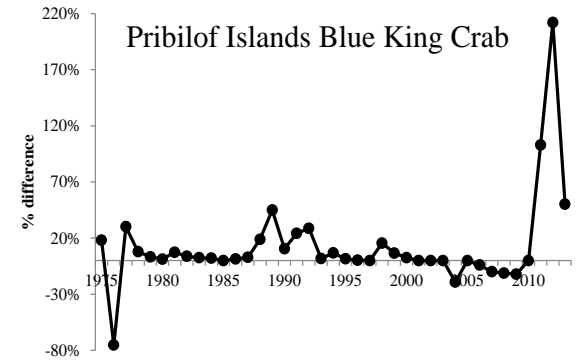
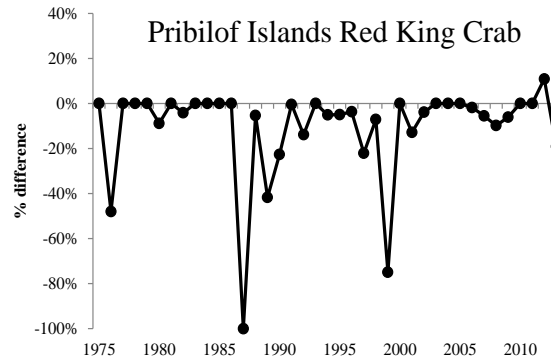
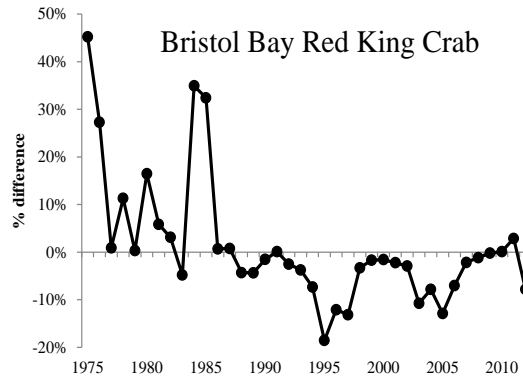
- Currently use ADFG cut line for both females and males
- Females: data available
 - Size at maturity
 - Mature abundance
- Males: data not available
 - Chela height data for Chionoecetes
 - Not feasible to measure all.
- Other data available??



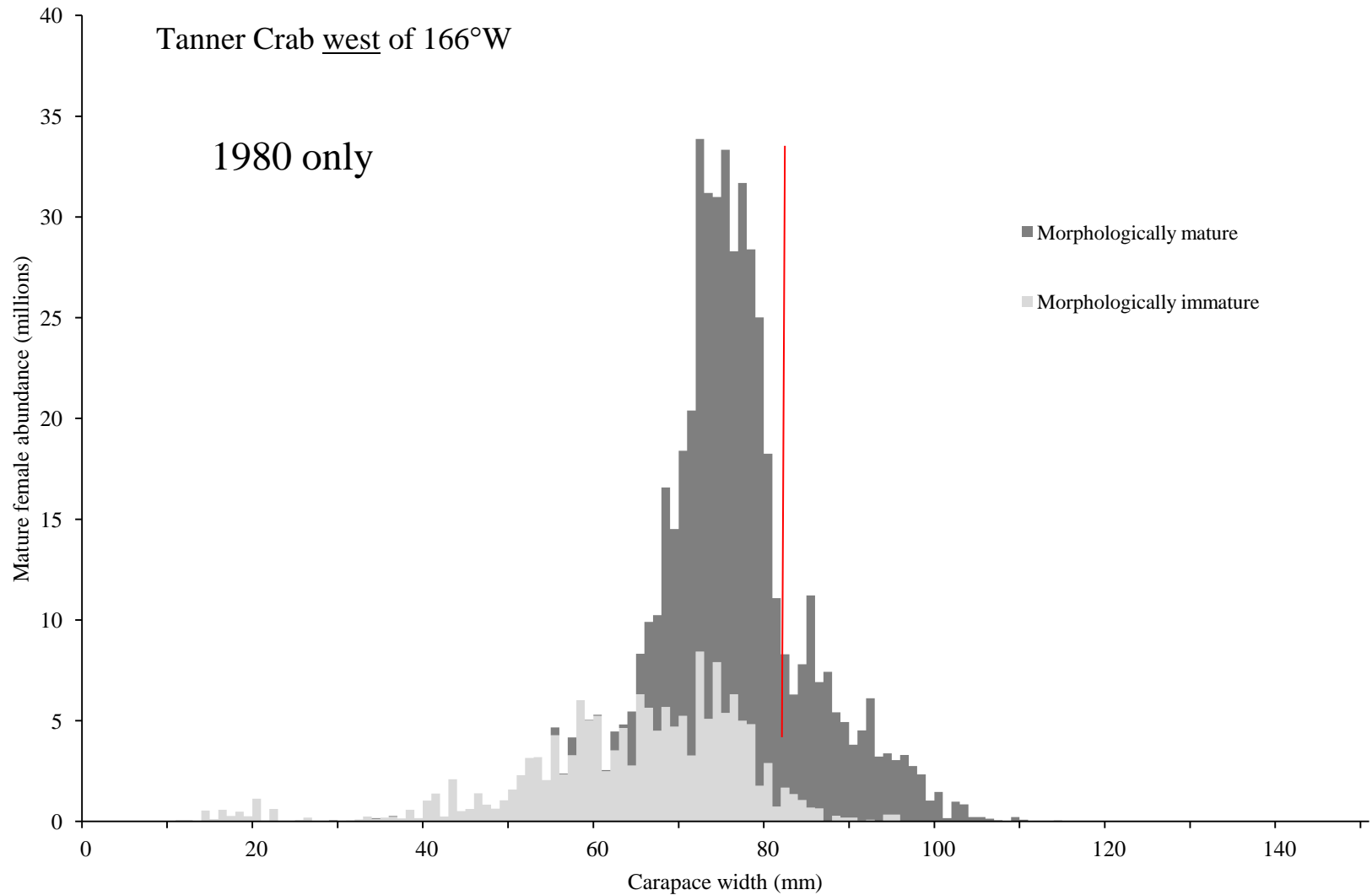
Mature biomass definition



Mature biomass definition



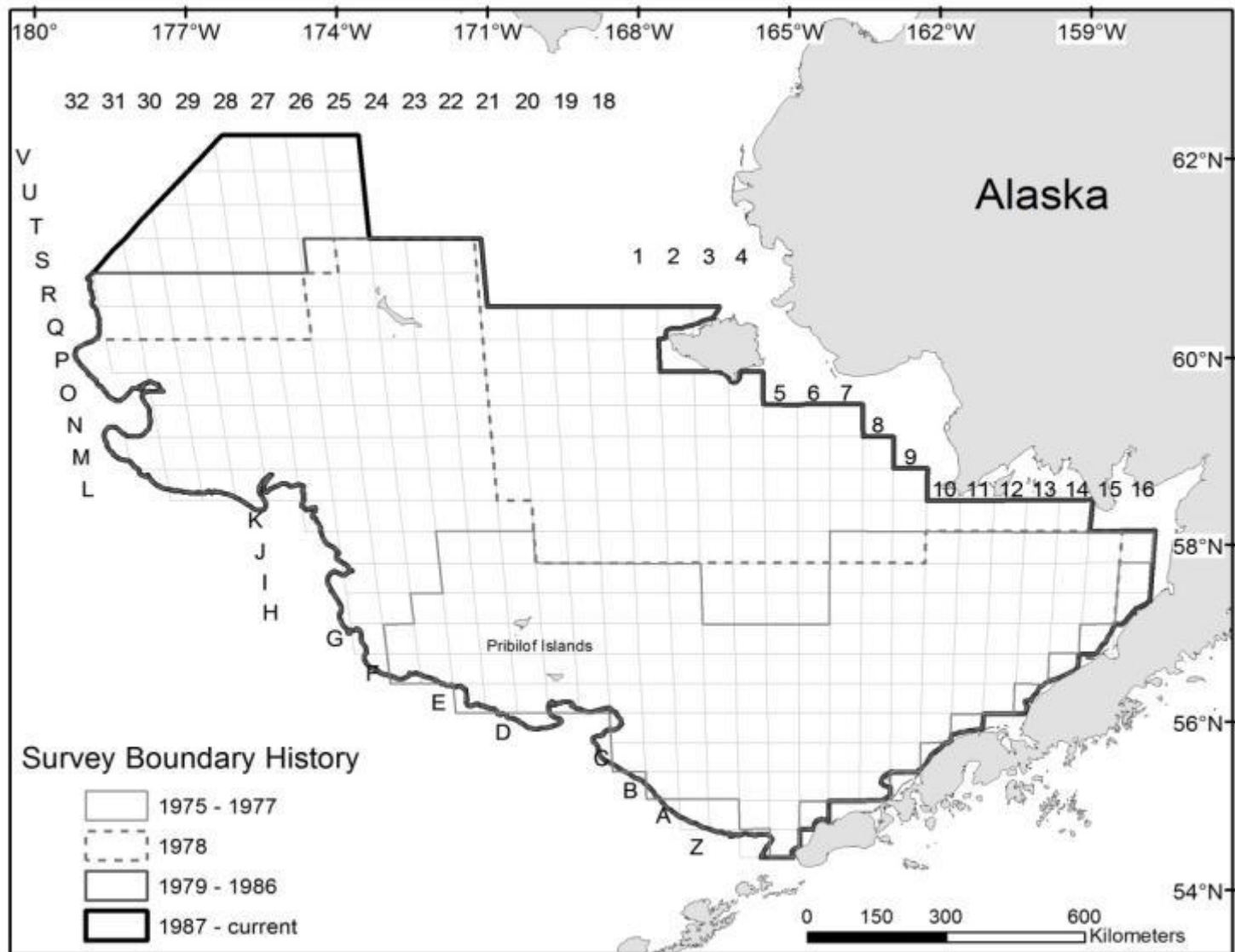
Mature biomass definition



Chionoecetes bairdi time series

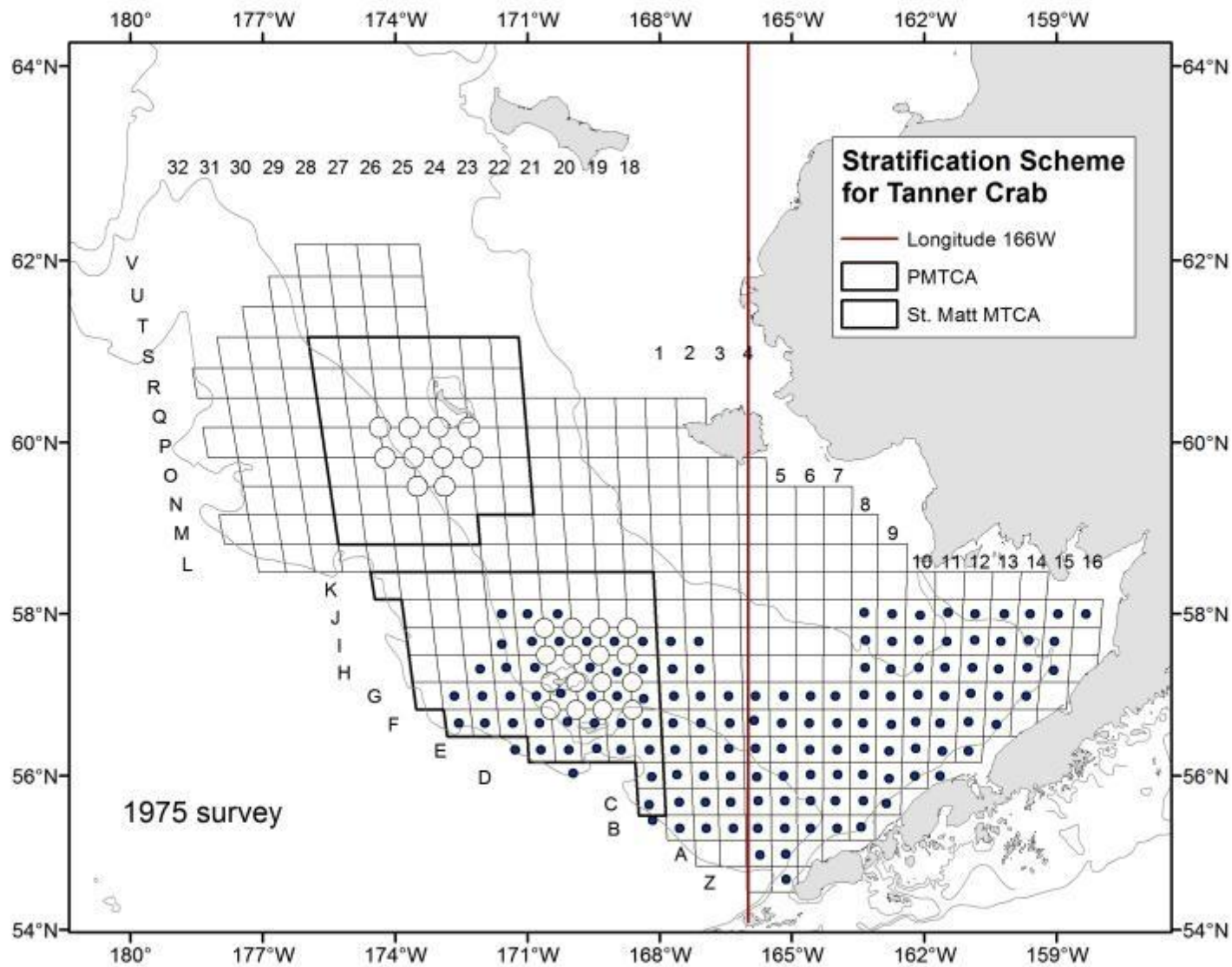
Strata and stations used

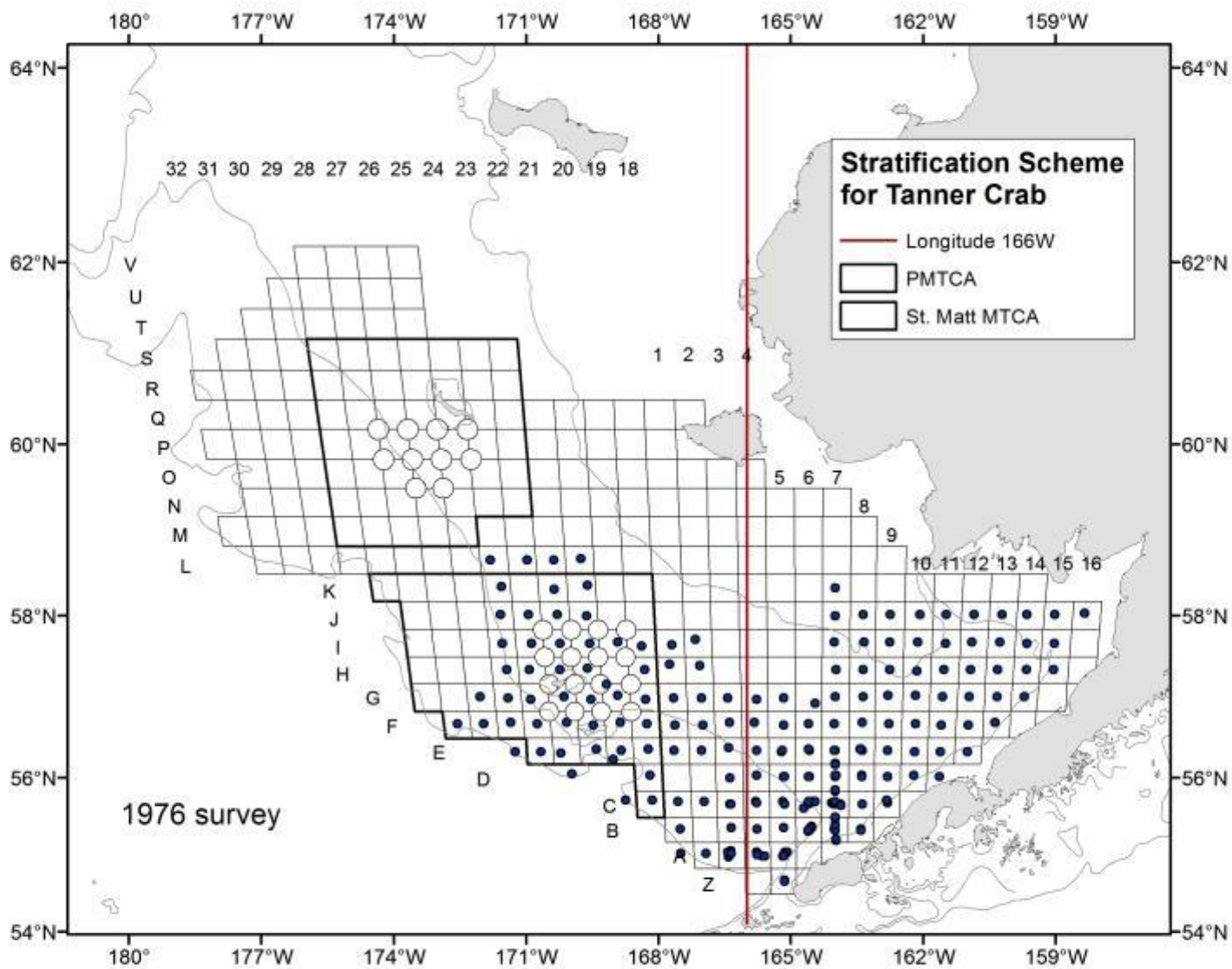
Survey Boundary History

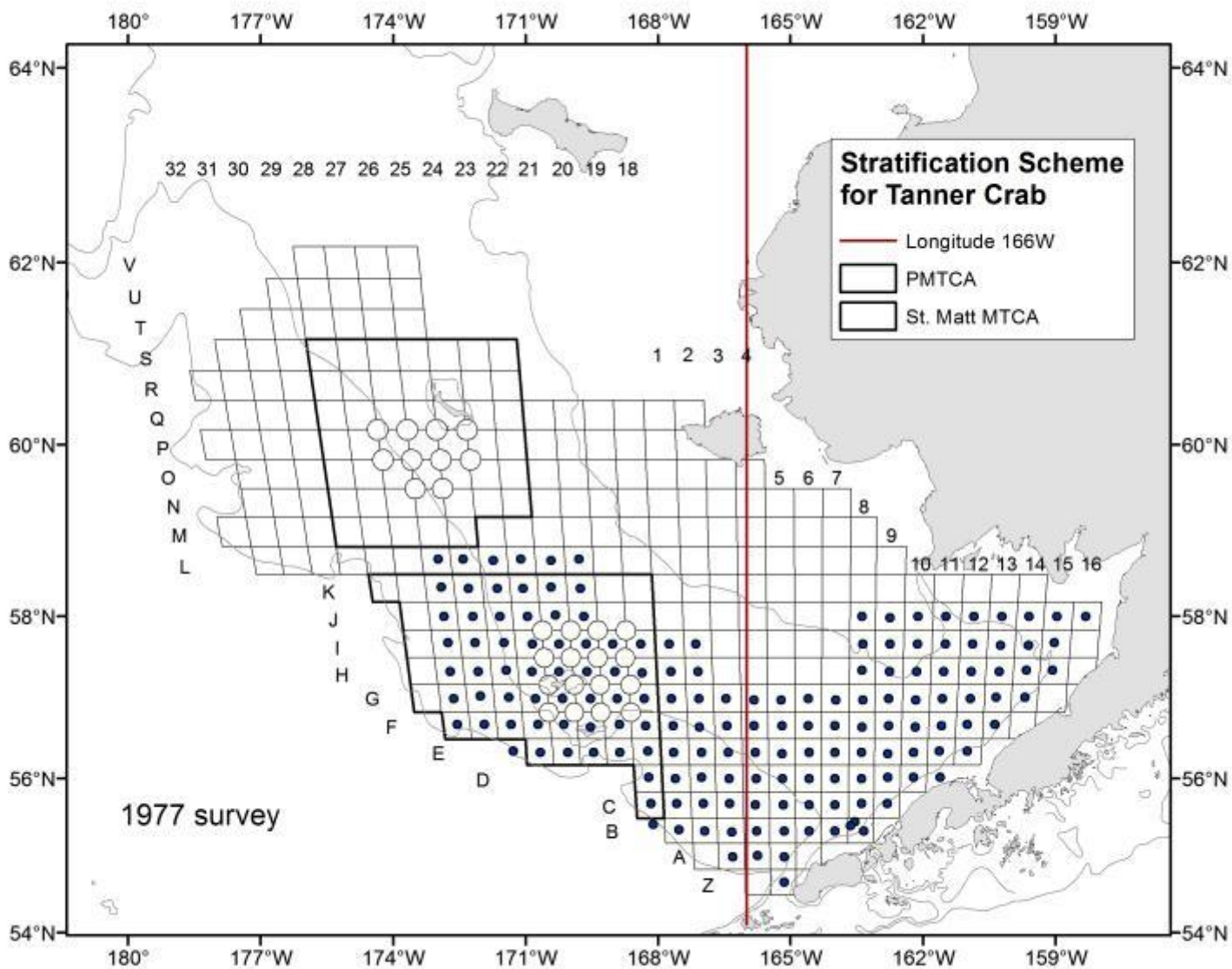


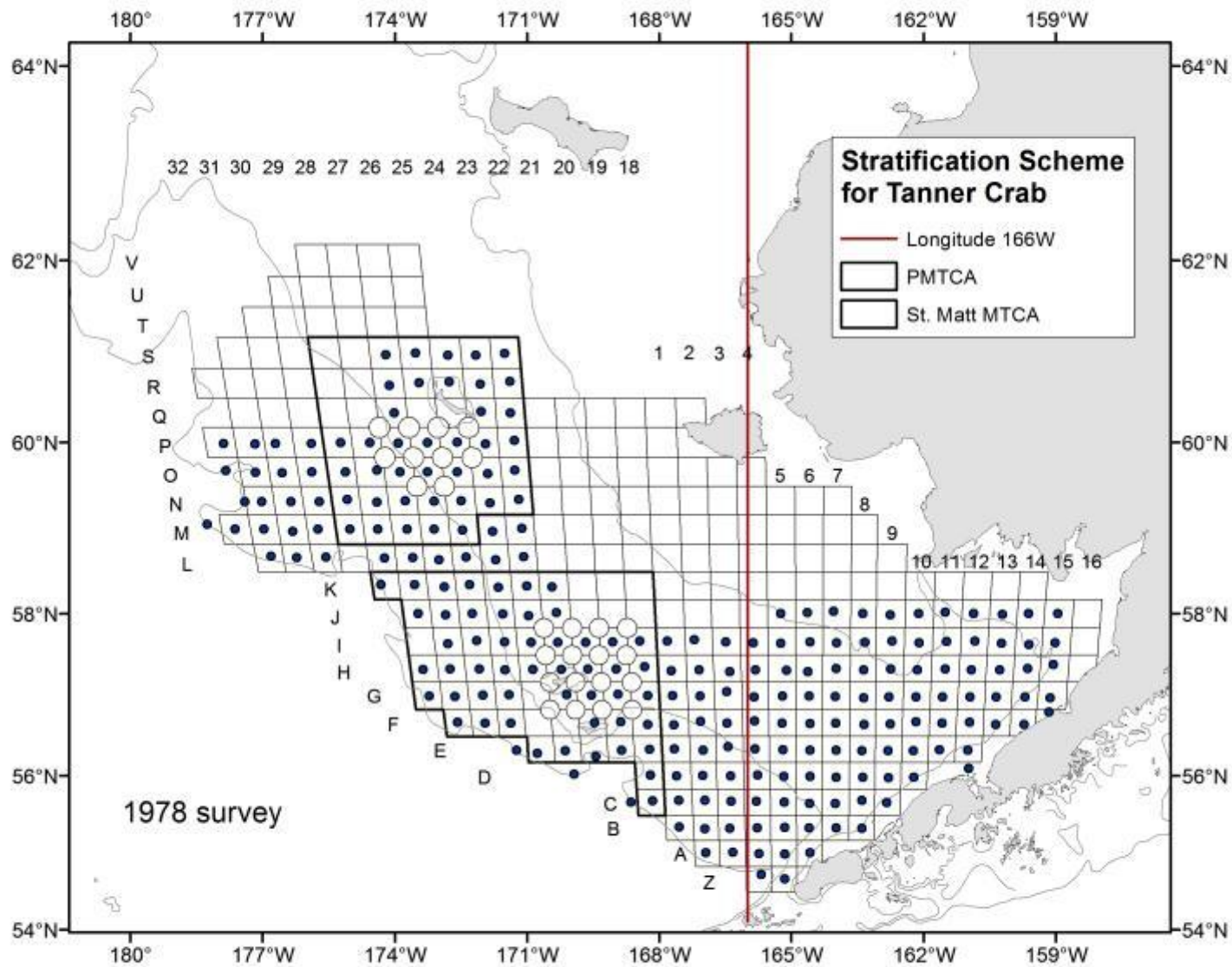
C. bairdi strata

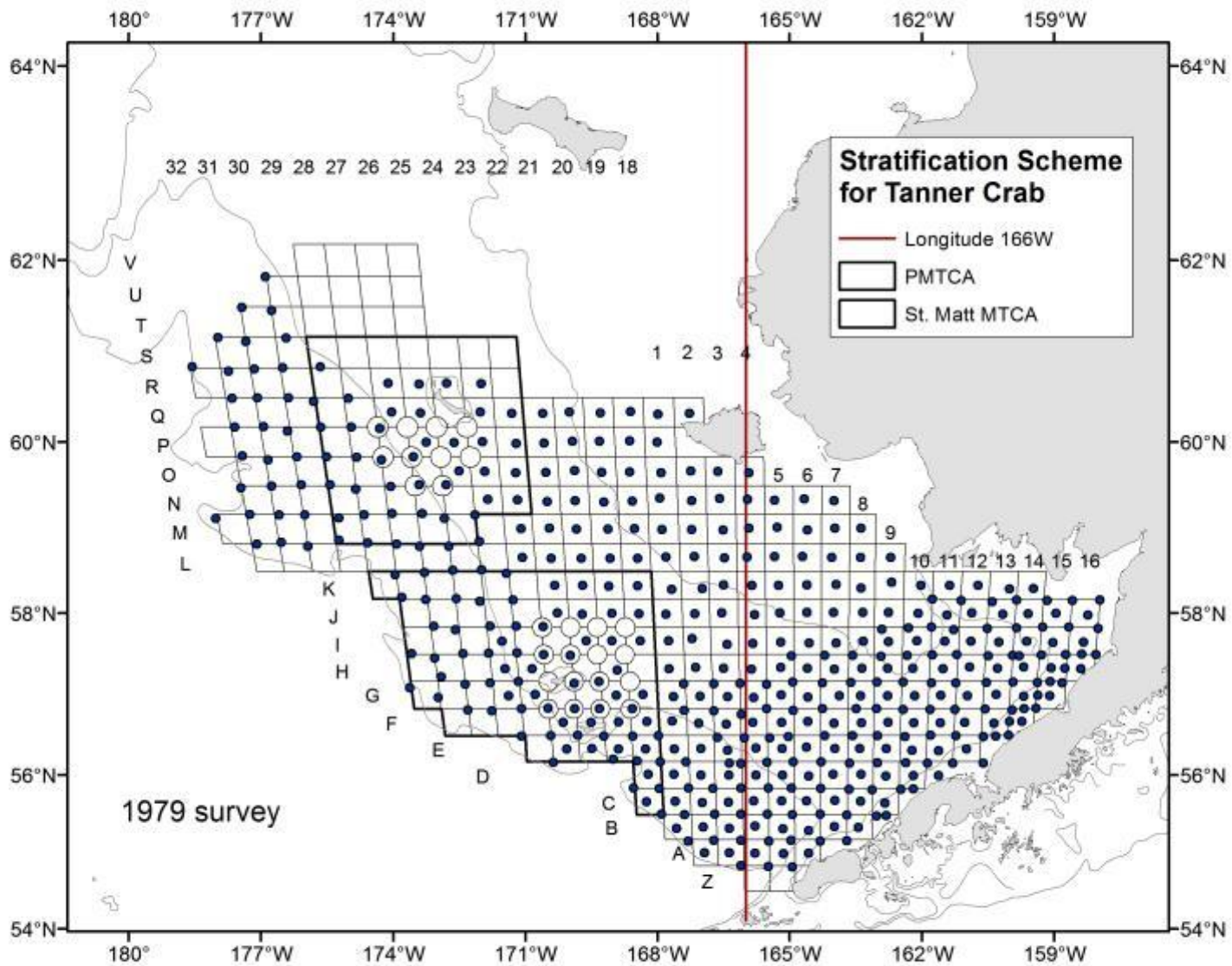
- stations east or west of 166W; Pribilof Multiple Tow Core Area; St. Matthew MTCA
- 1976-1982, 1987 and 1989: just those stations towed (survey area not standardized)
- 1983-1986: same basic grouping of stations used
- 1988, 1990-2013: all standard survey stations included
- Station area of poor performance tows included if Tanner crab have been caught at that station in the past

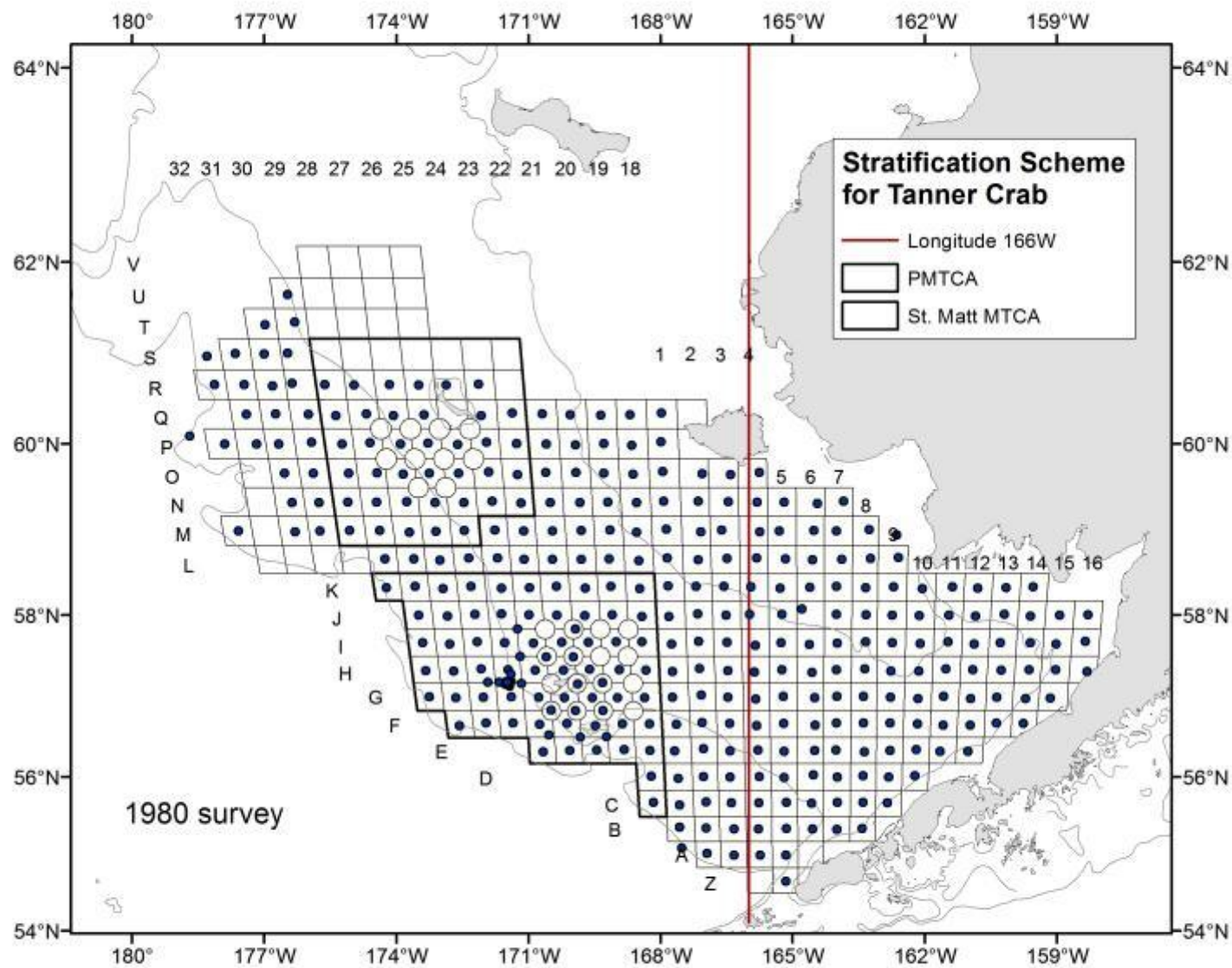


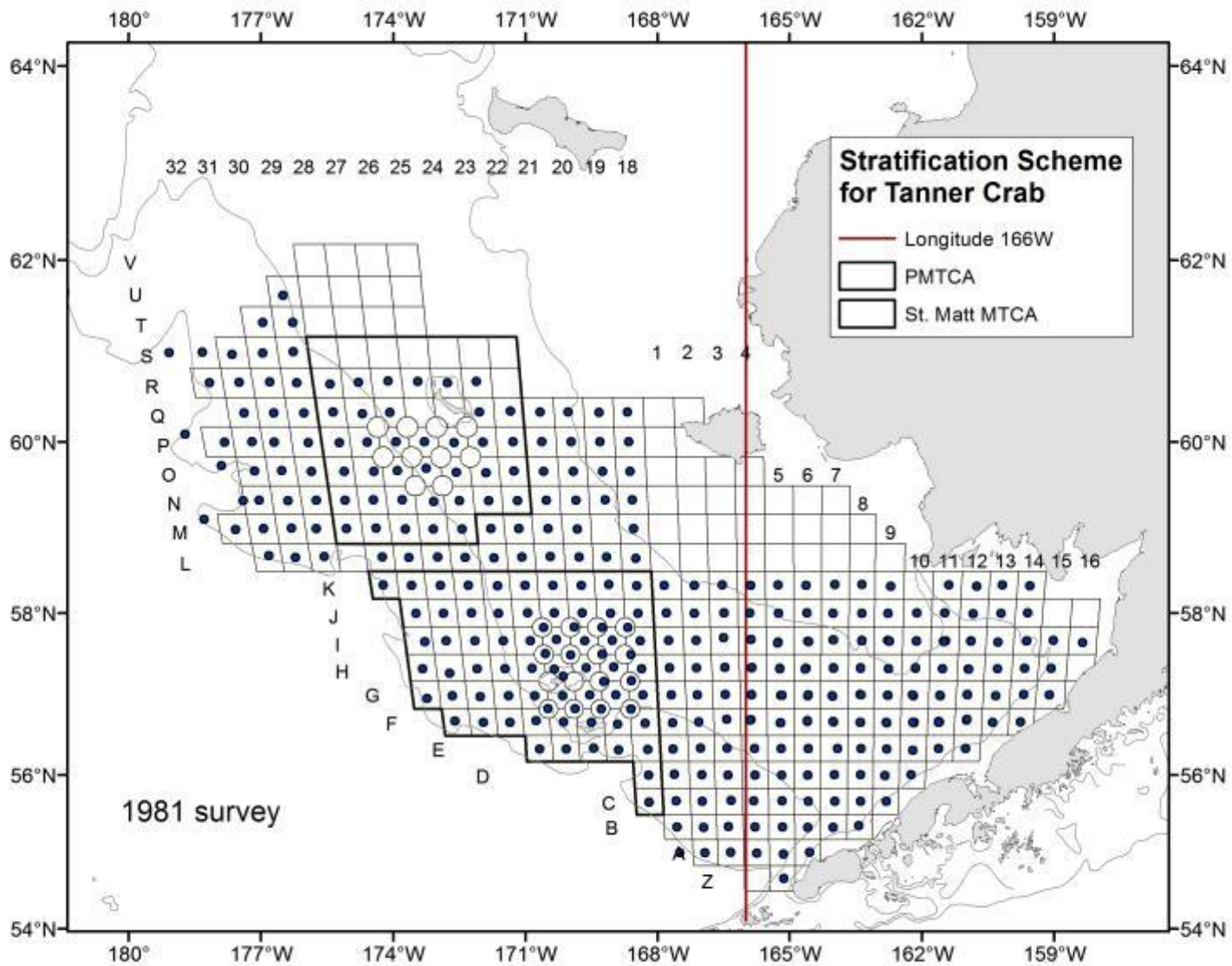


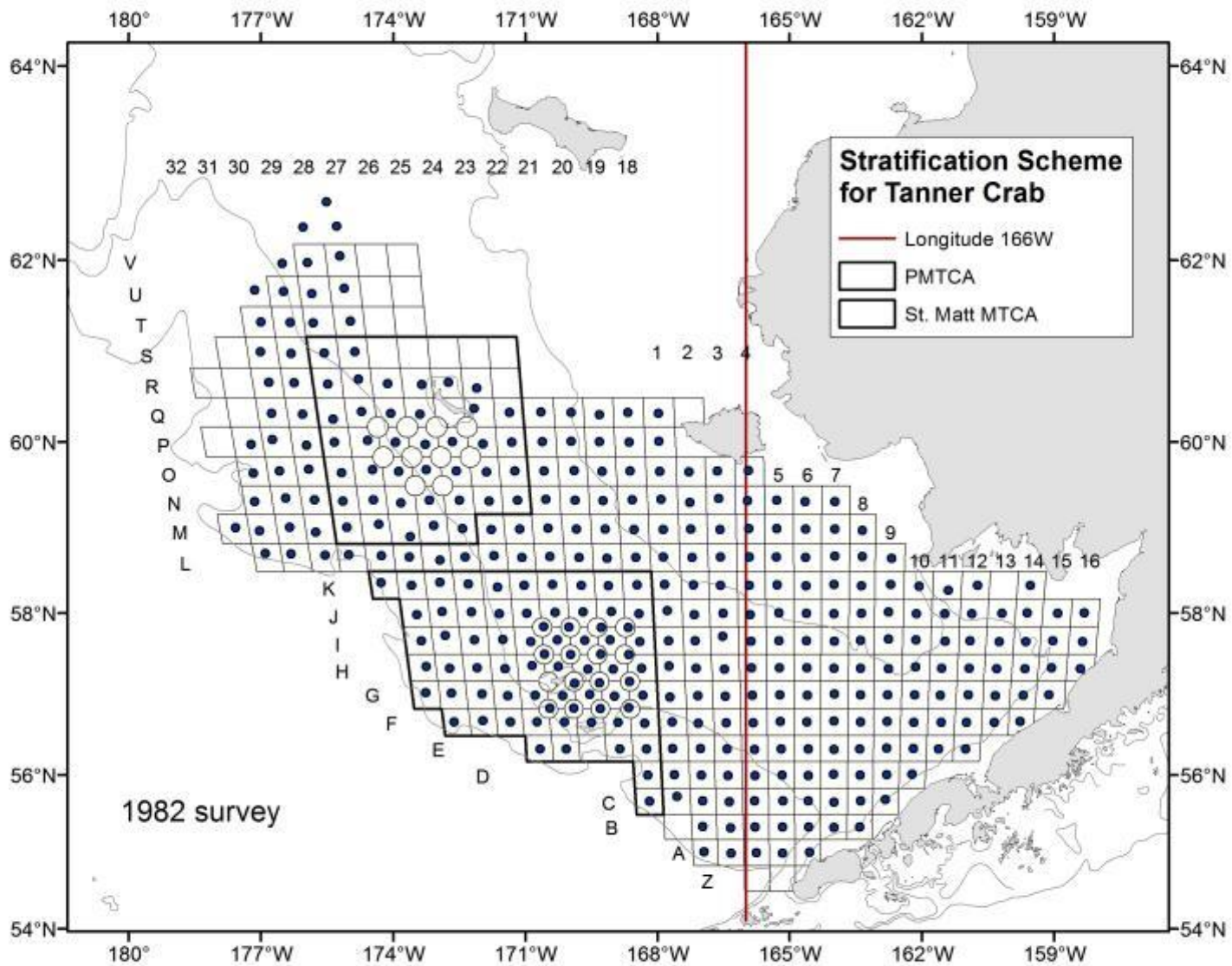


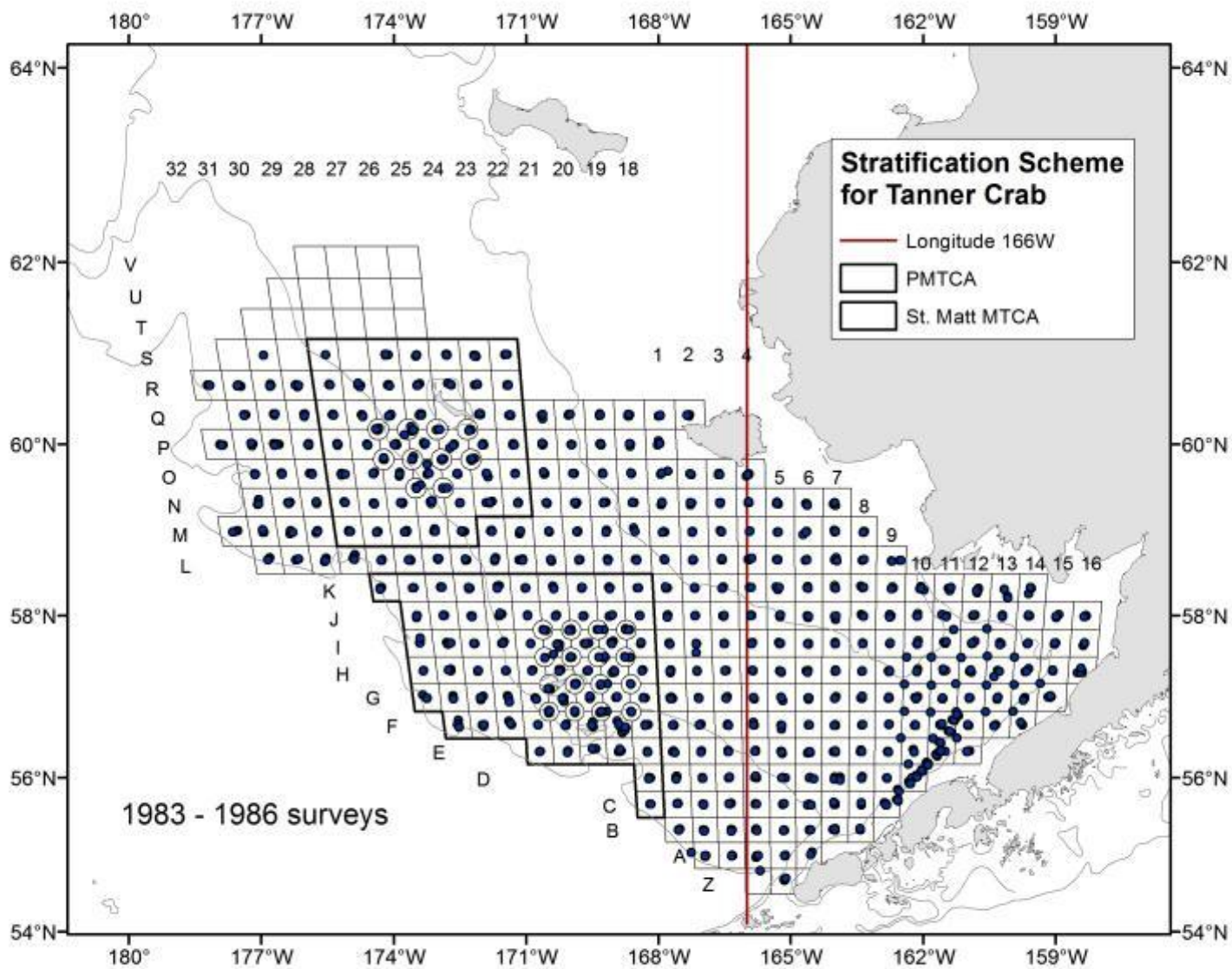


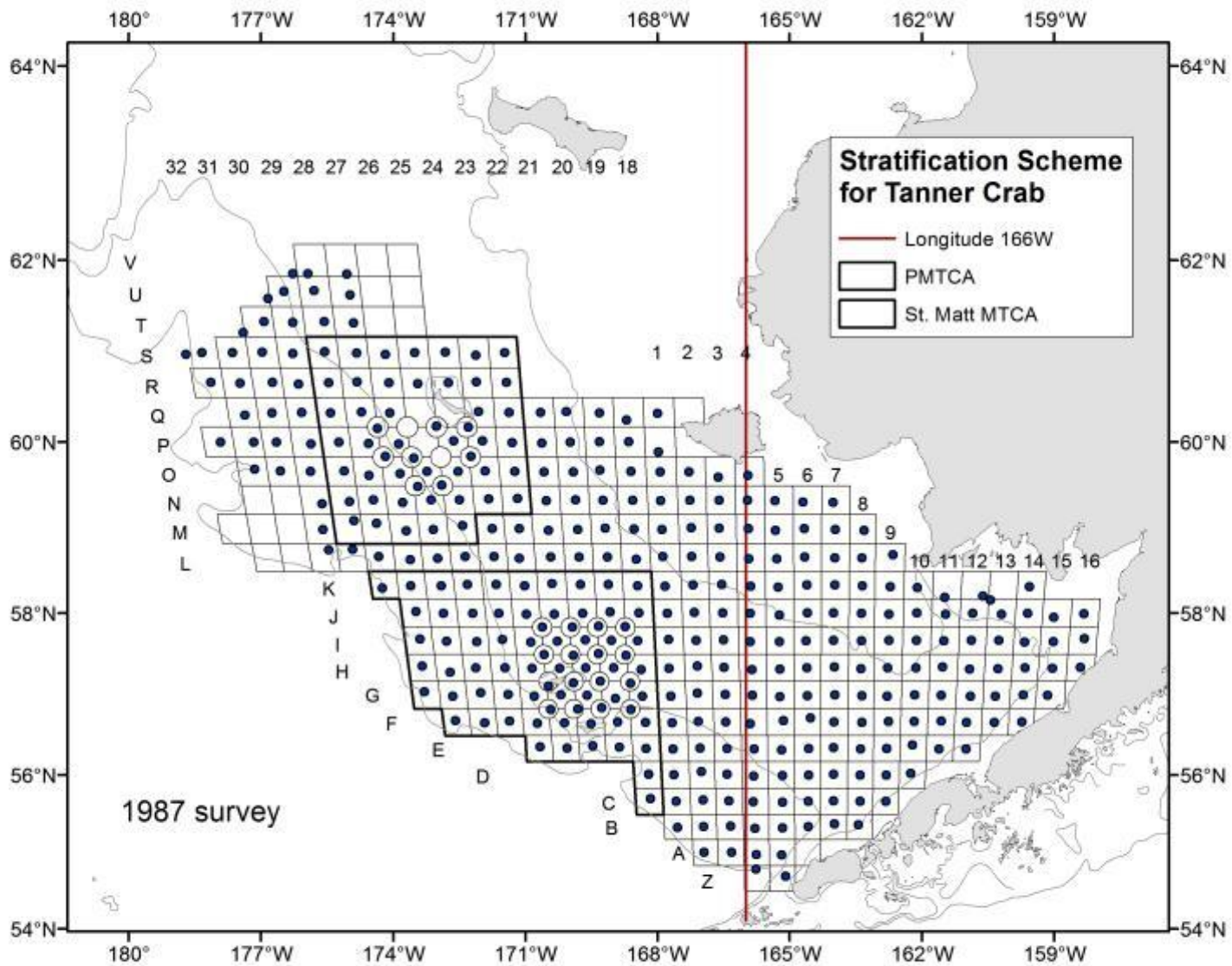


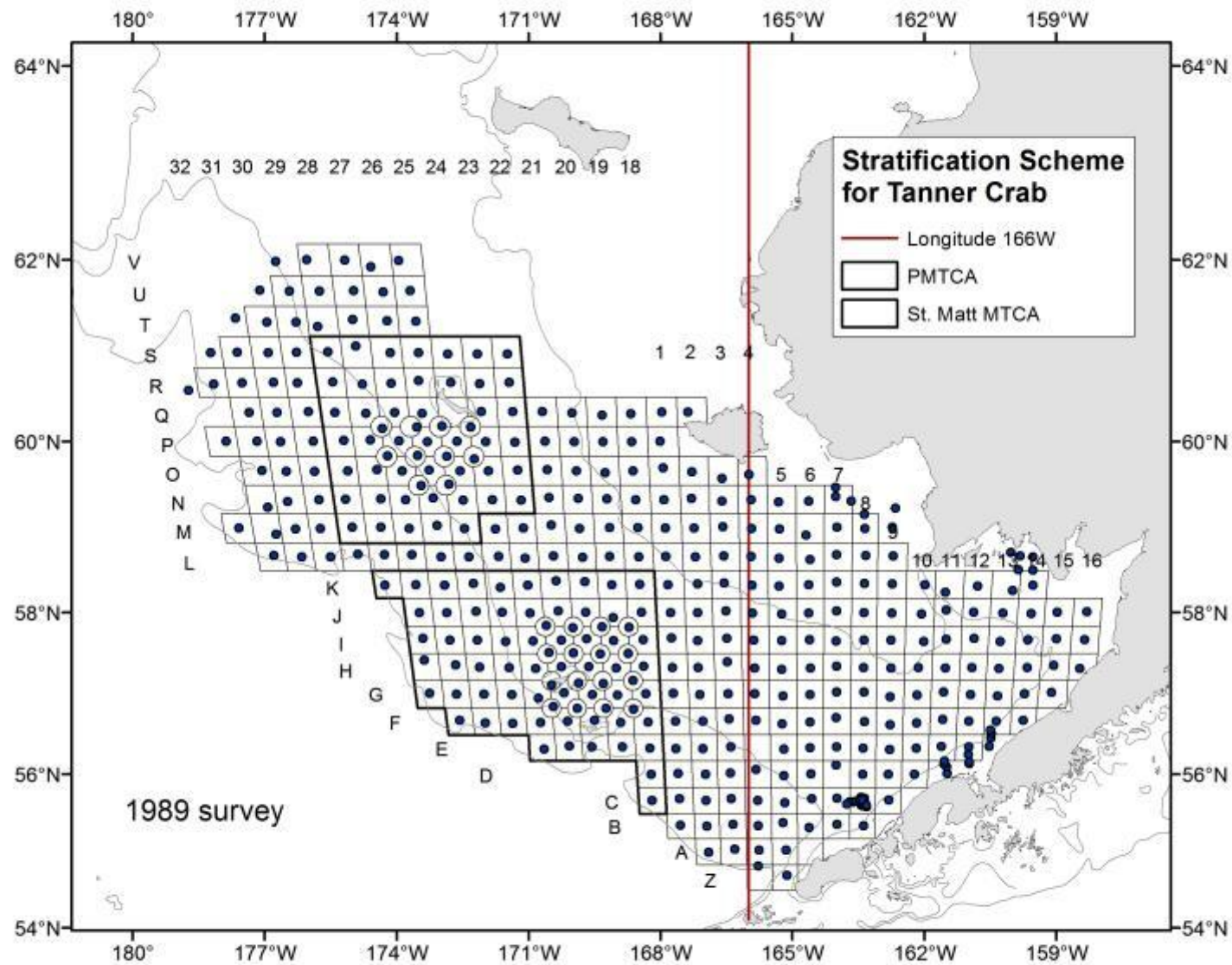


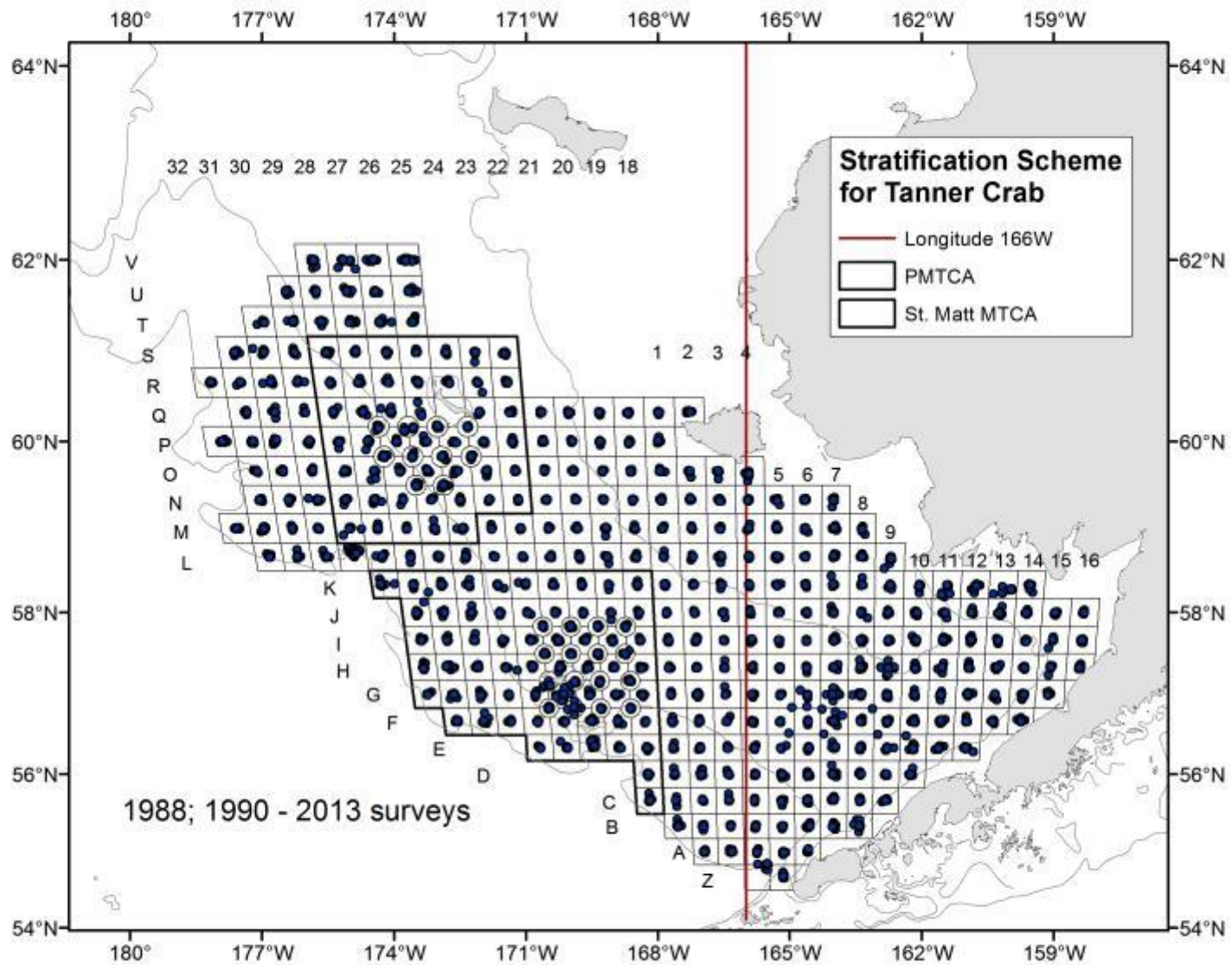












Survey Year	Vessels	Start date	End date	# stations	# tows	# BB retows	Tow duration (min)	Haul types	Gear/Accessories
1975	14	1-Jun	7-Aug	140	140		60	3	20/3
1976	14, 17, 19	19-May	9-Aug	150	214		25 - 60	0, 3	20/3, 30/4,30/359
1977	14	26-May	5-Aug	159	161		18 - 30	0, 3	20/34
1978	14, 28	20-May	15-Aug	239	239		18 - 30	3	20/34
1979	12, 14, 28	22-May	24-Aug	321	464		12 - 30	3	20/34
1980	14, 31	12-May	30-Jul	324	364		30 - 36	3, 4	20/34
1981	1, 37	22-May	28-Jul	312	355		24 - 30	3, 4	25/34, 26/34, 35/2
1982	1, 19	29-May	1-Aug	347	347		18 - 30	3, 4	33/15, 34/15
1983	1, 37	7-Jun	1-Aug	354	354		12 - 30	3, 15	37/15, 38/15
1984	1, 37	9-Jun	19-Aug	356	434		18 - 36	0, 3, 4	26/34, 35/2, 37/15, 38/15
1985	37, 60	8-Jun	9-Sep	355	355		12 - 42	3	38/15, 39/15
1986	37, 57	3-Jun	1-Aug	354	354		18 - 30	3	38/15, 40/15
1987	19, 37	27-May	30-Jul	361	362		12 - 36	3	38/15, 42/15, 43/15
1988	37, 78	4-Jun	30-Jul	370	373		18 - 36	3	44/15
1989	37, 78	4-Jun	14-Aug	386	437		12 - 30	3, 4, 5, 18, 21	44/15
1990	37, 78	4-Jun	6-Aug	371	384		12 - 36	0, 3	44/15
1991	37, 78	7-Jun	13-Aug	372	378		12 - 36	0, 3	44/15
1992	37, 87	5-Jun	3-Aug	356	356		12 - 30	3	44/15
1993	88, 89	4-Jun	26-Jul	375	378		12 - 36	0, 3	44/15
1994	88, 89	3-Jun	26-Jul	374	376		6 - 36	3, 19	44/15
1995	88, 89	4-Jun	22-Jul	375	380		12 - 36	3, 19	44/15
1996	88, 89	8-Jun	28-Jul	374	375		12 - 42	3	44/15
1997	88, 89	7-Jun	26-Jul	375	376		12 - 36	3	44/15
1998	88, 89	9-Jun	29-Jul	374	375		18 - 36	3	44/15
1999	88, 89	23-May	20-Jul	372	404	31	12 - 42	3, 17	44/15
2000	88, 89	23-May	23-Jul	372	395	23	12 - 36	3, 17	44/15
2001	88, 89	29-May	19-Jul	374	375		18 - 36	3	44/15
2002	88, 89	2-Jun	24-Jul	374	375		12 - 36	3	44/15
2003	88, 89	2-Jun	22-Jul	375	380		6 - 36	3, 19	44/15
2004	88, 89	5-Jun	25-Jul	374	383		6 - 30	3, 19	44/15
2005	88, 89	3-Jun	22-Jul	372	373		12 - 36	3	44/15
2006	88, 134	2-Jun	25-Jul	375	410	30	12 - 30	3, 17, 19, 20	44/15
2007	88, 89	11-Jun	30-Jul	375	412	32	12 - 30	3, 17, 19	44/15
2008	88, 89	4-Jun	25-Jul	374	410	32	12 - 36	3, 17, 19	44/15
2009	88, 89	2-Jun	30-Jul	375	408	32	18 - 36	3, 17	44/15
2010	89, 162	7-Jun	4-Aug	375	403	23	12 - 42	3, 17, 19	44/15
2011	89, 162	5-Jun	31-Jul	375	396	20	12 - 36	3, 17	44/15
2012	89, 162	4-Jun	2-Aug	375	396	20	18 - 36	3, 17	44/15
2013	89, 162	9-Jun	1-Aug	375	376		18 - 36	3	44/15

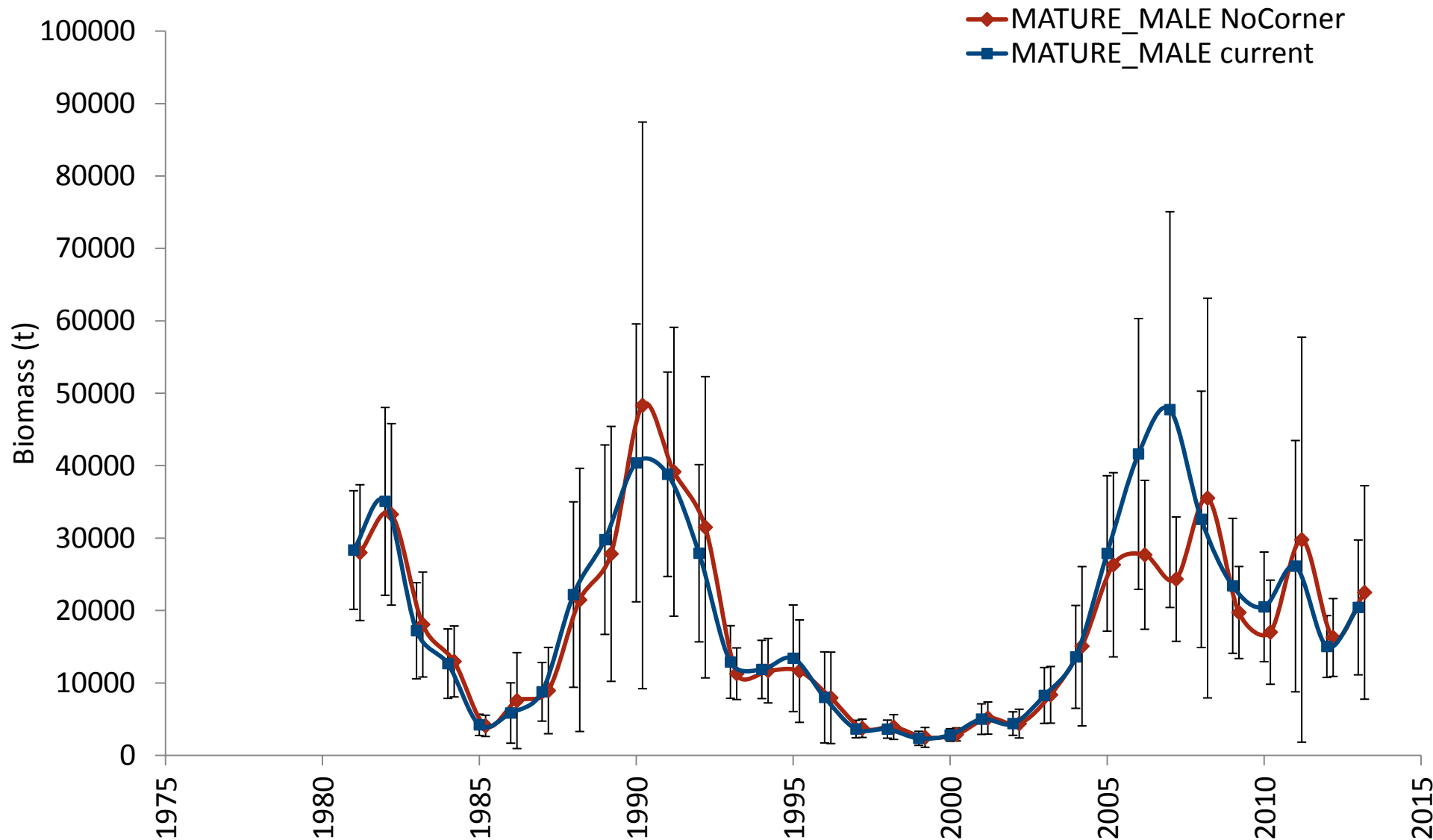
- 1 Pribilof corner stations start
- 2 400-mesh eastern to 83-112 net
- 3 St. Matthew corner stations added
- 4 20 stations added to northwest
- 5 F-06 red king crab data not included in original abundance estimation, but is included in current data set
- 6 18 stations dropped from 1992 survey
- 7 Bristol Bay retows for red king crab only
- 8 only certain OCS tows used, not all
- 9 tows were 1-hour duration
- 10 last year of hot spot tows

Survey Year	Standard Stations	Hot Spot	Bristol Bay Retow	Extra Tows	OCSEAP
1975	X ⁹			X	X
1976	X ⁹			X	X ⁸
1977	X			X	
1978	X			X	
1979	X			X (all std haul type)	
1980	X			X	
1981	X ¹			X	
1982	X ²			X	
1983	X ³			X	
1984	X			X	
1985	X			X	
1986	X			X	
1987	X			X	
1988	X ⁴			X	
1989	X			X	
1990	X	X		X	
1991	X ⁵			X	
1992	X ⁶				
1993	X	X		X	
1994	X	X		X	
1995	X	X		X	
1996	X			X	
1997	X			X	
1998	X			X	
1999	X		X ⁷	X	
2000	X		X ⁷	X	
2001	X			X	
2002	X			X	
2003	X	X		X	
2004	X	X		X	
2005	X			X	
2006	X	X	X ⁷	X	
2007	X	X	X ⁷	X	
2008	X	X	X ⁷		
2009	X		X ⁷	X	
2010	X	X ¹⁰	X ⁷	X	
2011	X		X ⁷	X	
2012	X		X ⁷	X	
2013	X			X	

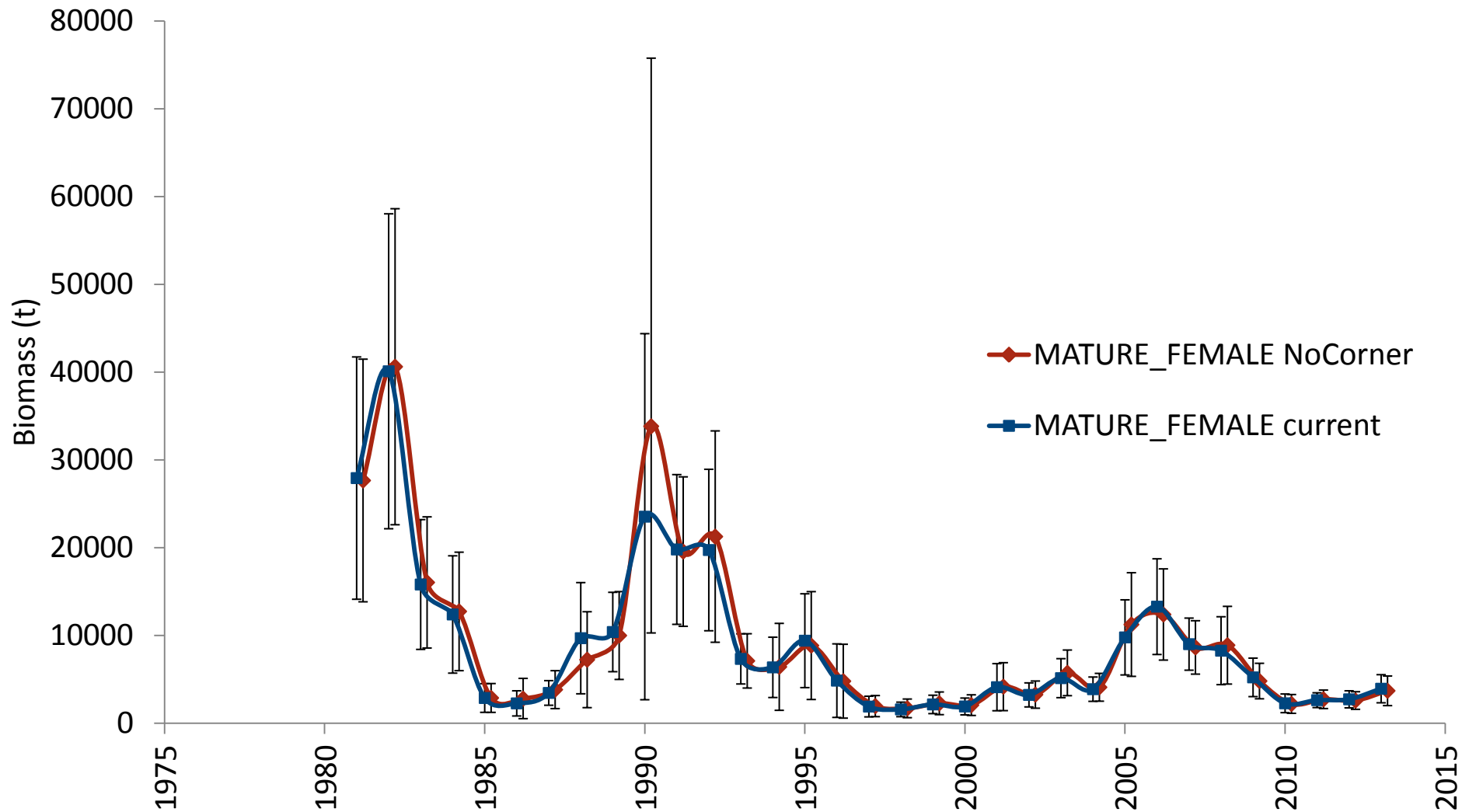
Future Time Series – what data to include.

- Current time series
- No corner stations
- No hot-spot tows
- Only standard tows

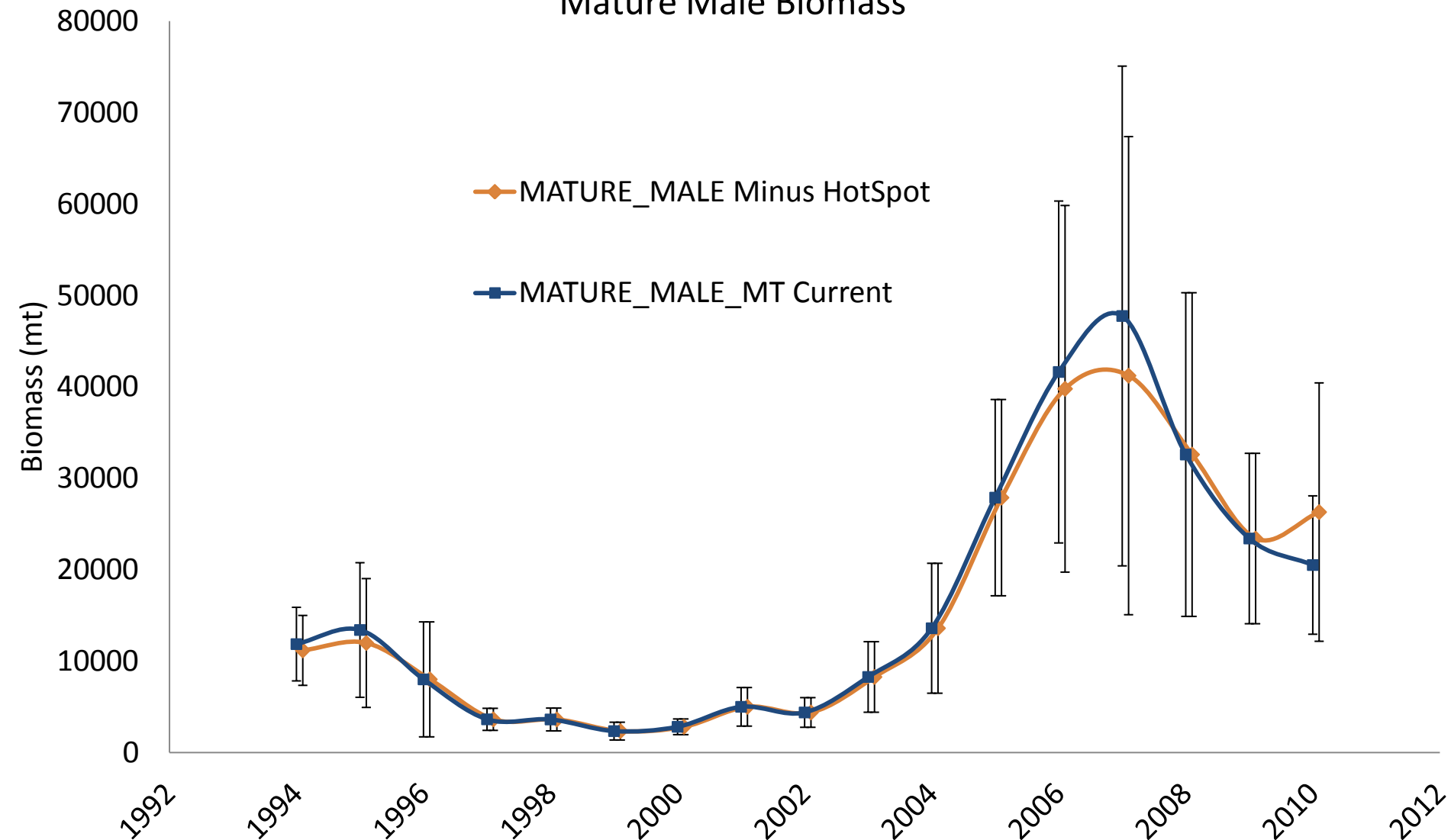
W166 C. bairdi Minus Corner Stations Mature Male Biomass



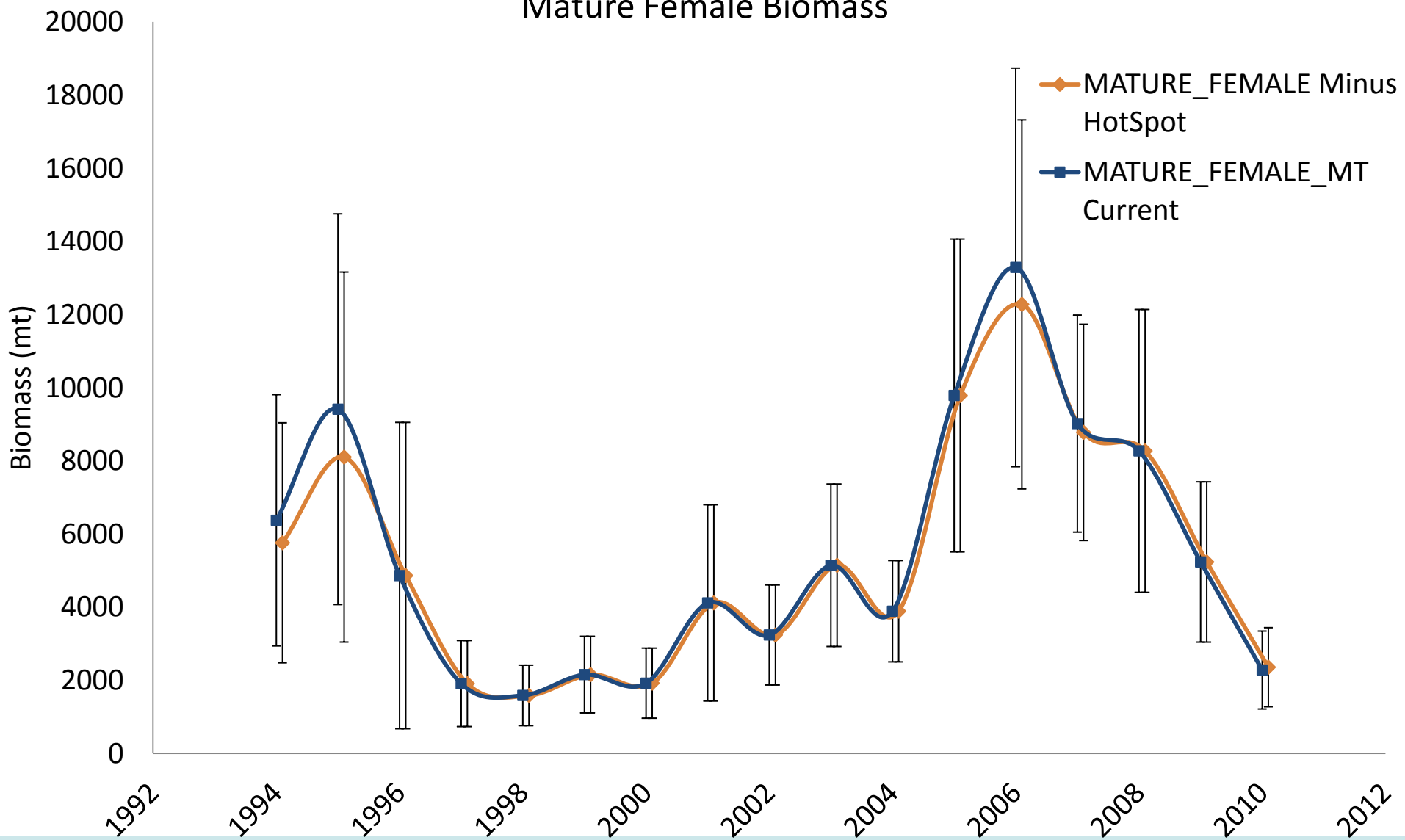
W166 C. bairdi Minus Corner Stations Mature Female Biomass



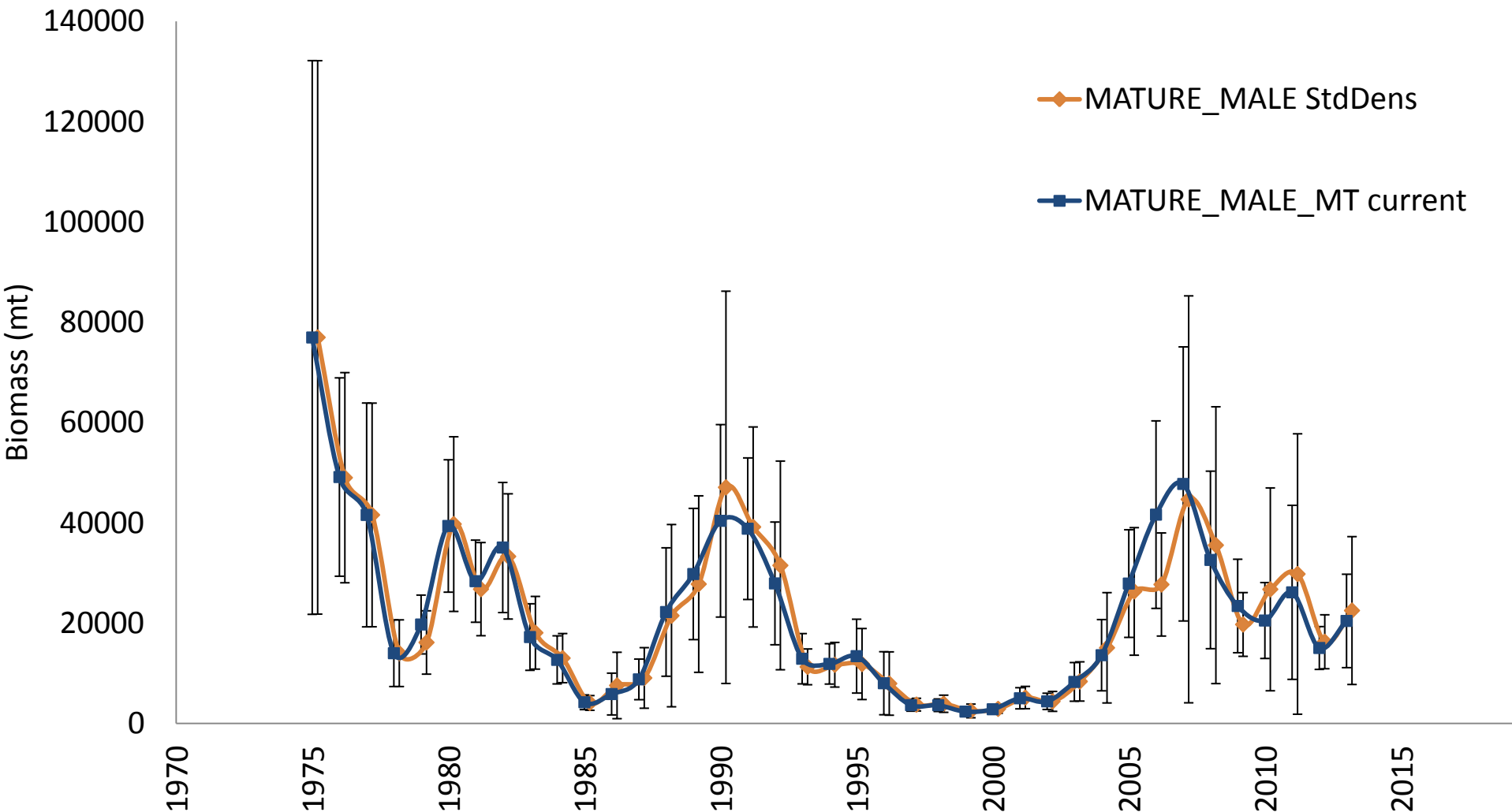
W166 C. bairdi Hot Spot Comparison Mature Male Biomass



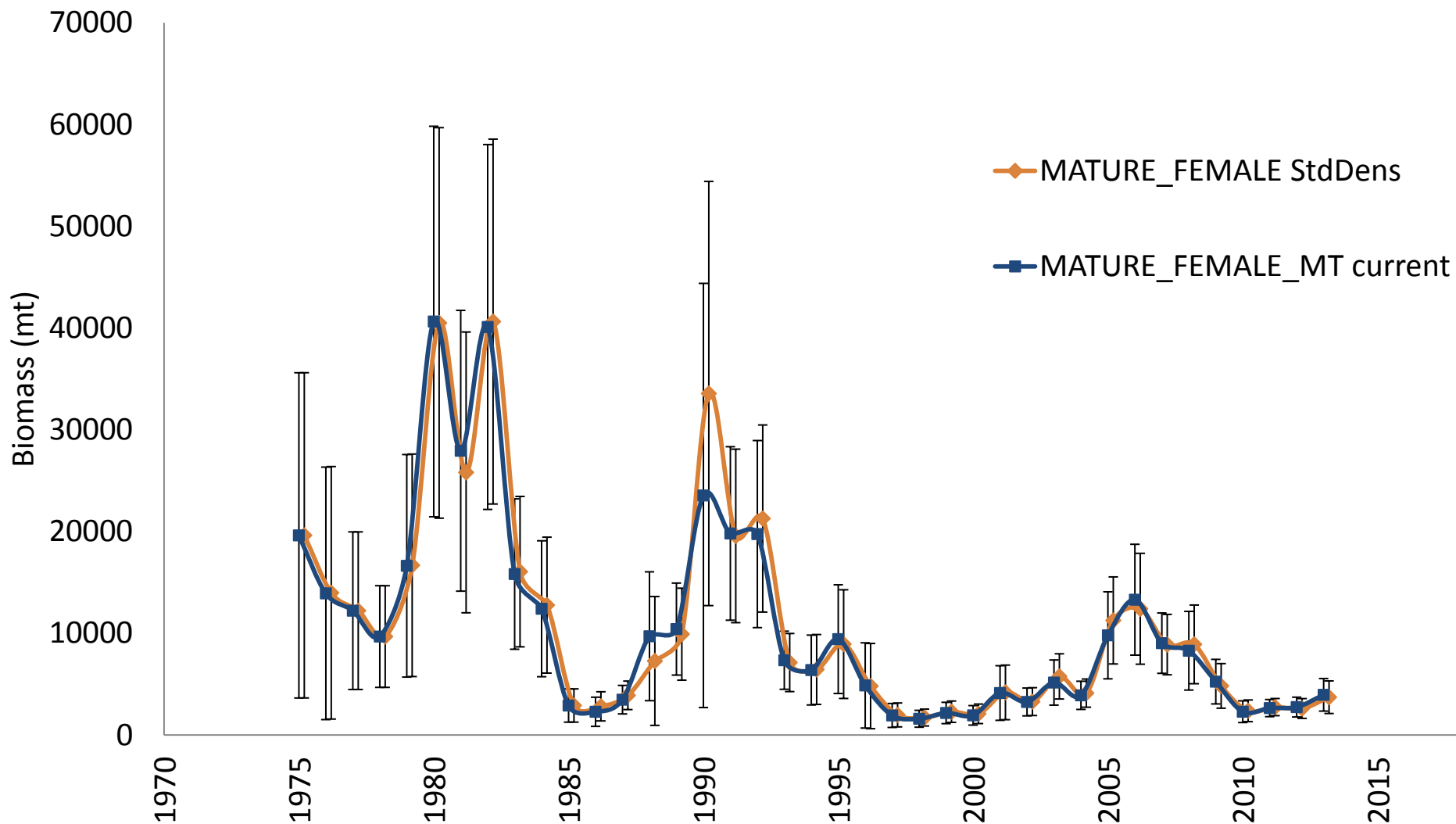
W166 C. bairdi Hot Spot Comparison Mature Female Biomass



W166 C. bairdi Standard Density Mature Male Biomass



W166 C. bairdi Standard Density Mature Female Biomass



Abundance and Biomass calculation

Survey Abundance Estimate

Station assignment based on midpoint of tow

$$CPUE_{cell\ i} = \frac{CrabCount}{AreaSwept(nm^2)}$$

$$\overline{CPUE}_{strata} = \frac{\sum_{i=1}^{n_t} CPUE_{cell\ i}}{n_t}$$

$$A_{strata} = SA \times \overline{CPUE}_{strata}$$

$$A_t = \sum_{j=1}^k SA_j \times \overline{CPUE}_{strata, j}$$

Survey Variance Estimate

$$Var(A) = SA^2 \times Var(\overline{CPUE}_{cell}) = SA^2 \frac{\sum (CPUE_{cell\ i} - \overline{CPUE}_{cell})^2}{n_t(n_t - 1)}$$

$$Var(A) = \sum_{j=1}^k SA_j^2 \times Var(\overline{CPUE}_{cell, j})$$

Questions

- Unmeasured crab: OK to “fill in the blanks”?
- Mature abundance for females?
- How to better incorporate chela measurements?
- Specific analyses of time series?
- Additional time series?
 - Average multiple hauls within a station and then remove strata.

Data for use in crab assessments: Where do they come from?

Data for use in crab assessments: Where do they come from?

- Groundfish bycatch: AKRO (next slide)
- Groundfish bycatch length-freq: FMA (NMFS observer program)
 - Not necessarily representative
- Crab fishery bycatch: ADFG observer program
- Crab fishery retained catch length-freq: ADFG observer program

Pre 1991: Data available in INPFC reports only.

1991- December 2002: The “blend method”.

- Combined data from industry production reports and observer reports. Bycatch estimates were derived from a combination of observer and landing (catcher vessels/production data). Production data included CPs and catcher vessels delivering to motherships.

January 2003 –December 2007:

- Catch Accounting System (CAS) uses a ratio estimator derived from observer data (counts of crab/kg groundfish) that is applied to production/landing information.

January 2008- 2012:

- Method to speciate broken crab fixed.
- Haul-level weights collected by the observers used to estimate the weight in CAS instead of applying an annual (global) weight factor. Spatial resolution was at federal reporting area.

NEW Data January 2009 – Current: Available August 2013.

- ADFG reporting area. This method uses ratio estimator (wt crab/wt groundfish) applied to groundfish reported on production/landing reports.
- Aggregates observer data to the stock area level.
- 2009 is the start of the data set because that’s the first year identification of state statistical areas was required on groundfish production reports.